Roller Member

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a roller member which can be used for imparting a charge, eliminating a charge, or removing toner adhered onto the surface of a transfer belt or a transfer-conveyor belt, in any of a variety of OA apparatuses such as copy machines and printers.

Background Art

In a typical electrophotography process, a photosensitive substance is subjected to several processes, including charge-imparting, exposure, development, transfer, and cleaning. In such an electrophotography process, because the toner is charged in reverse, and also because of defects or stains present on the surface of a transfer member, or unsatisfactory transfer, toner cannot be completely transferred onto a transfer medium, and remains on the surface of the transfer member to some extent. Since such residual toner impedes formation of a clear copy image in an electrophotography process in the next cycle, a cleaning process must be carried out after the transfer process.

In a conventional cleaning process, a cleaning blade having an elastic rubber member such as urethane rubber and a metallic holder, the rubber member being fixed onto the holder, is physically brought into contact with a rotating transfer belt; a space between the transfer belt and the

cleaning blade is eliminated to thereby prevent toner from passing through the space; and toner which remains on the transfer belt is scraped off.

Alternatively, toner adhered onto a transfer belt is removed by transferring the toner onto a metallic roller, and the toner transferred onto the surface of the metallic roller is scraped off by bringing a cleaning blade into contact with the metallic roller.

However, in the aforementioned cleaning process, toner is not removed efficiently. Due to such low efficiency, toner filming tends to occur on the transfer belt, and thus the service life of the transfer belt may be reduced.

SUMMARY OF THE INVENTION

In view of the foregoing, an object of the present invention is to provide a roller member exhibiting enhanced durability, as well as improved cleaning characteristics and charge-imparting or charge-eliminating characteristics.

Accordingly, the present invention provides a roller member comprising a metallic core roller and an unshrinkable sleeve which is heat-welded onto the surface of the roller, which sleeve is formed from an elastomer material and has a Young's modulus of 120-200 MPa.

The unshrinkable sleeve may be formed from a material selected from the group of polyamides, polyamide elastomers, fluorine-containing polymer compounds, and fluorine-containing elastomers.

The welding force between the core roller and the unshrinkable sleeve may be 0.1 kg/cm or more.

The unshrinkable sleeve may have a surface resistivity of 10^6 to 10^{12} Ω/□.

The unshrinkable sleeve may have a surface roughness (Rz) of 5 μm or less.

The unshrinkable sleeve may have a thickness of 30-200 μm.

The unshrinkable sleeve may have an inner diameter smaller than the outer diameter of the core roller.

The material of the core roller is not particularly limited, but the roller is preferably formed from a metal such as SUS or SUM.

BRIEF DESCRIPTION OF THE DRAWING

Various other objects, features, and many of the attendant advantages of the present invention will be readily appreciated as the same becomes better understood with reference to the following detailed description of the preferred embodiments when considered in connection with the accompanying drawing, in which:

Fig. 1 is a schematic representation showing an embodiment of the roller member of the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Fig. 1 shows an embodiment of the roller member of the present invention. As shown in Fig. 1, a roller member 1 is

provided so as to be brought into close proximity with a transfer belt or a transfer-conveyor belt 10, and the roller member 1 serves as a cleaning roller for cleaning the surface of the transfer belt or the transfer-conveyor belt 10. Specifically, the roller member 1 of the present invention includes a core roller 3 having a shaft 2 in its center, and an unshrinkable sleeve 4 provided on the surface of the core roller 3. When a charge is imparted to the unshrinkable sleeve 4, toner 11 adhered onto the surface of the transfer belt 10 is transferred onto the roller member 1, to thereby reliably remove the toner from the surface of the transfer belt 10 and clean the belt 10. The toner 11 adhered onto the roller member 1 is scraped off, for example, by bringing the surface of the roller member 1 into physical contact with a cleaning blade 12 formed from, for example, an elastic material.

The unshrinkable sleeve 4 employed in the roller member 1 of the present invention has a Young's modulus of 120-200 MPa, and is substantially unshrinkable. The material of the unshrinkable sleeve 4 must be an elastomer or elastomer-like material, rather than a resin. Thus, the unshrinkable sleeve 4 is preferably formed from a polyamide (PA), a polyamide elastomer (PAE), or a fluorine-containing polymer compound or fluorine-containing elastomer, such as PFA, PTFE, or ETFE. When the Young's modulus of the unshrinkable sleeve 4 is in excess of the above range, toner particles may be crushed by the sleeve, whereas when the Young's modulus is below the

above range, the durability of the sleeve may be lowered.

The surface resistivity of the unshrinkable sleeve 4 is preferably 10^6 to 10^{12} $\Omega/\square$. When the surface resistivity falls outside this range, toner may fail to be transferred onto the roller member satisfactorily; i.e., the toner may fail to be removed from the transfer belt or the belt may fail to be cleaned.

The surface roughness (Rz) of the unshrinkable sleeve 4 is preferably 5 μm or less. When the surface roughness is in excess of 5 μm, the sleeve may cause damage to a contact target or the blade abutting the roller member.

The unshrinkable sleeve 4 is heat-welded onto the surface of the core roller 3, and the welding force between the core roller 3 and the unshrinkable sleeve 4 is preferably 0.1 kg/cm or more, more preferably 0.2 kg/cm or more.

The unshrinkable sleeve 4 may have an inner diameter smaller than the outer diameter of the core roller 3, and the core roller 3 is pressed into the sleeve 4 and coated therewith. This is because, when the inner diameter of the unshrinkable sleeve 4 is larger than the outer diameter of the core roller 3, the aforementioned welding force cannot be obtained.

The unshrinkable sleeve 4 may be joined with the core roller 3 through heat-welding; i.e., the sleeve 4 is joined with the core roller 3 without application of an adhesive. Therefore, the unshrinkable sleeve 4 is welded onto the core roller 3 without the intervention of an adhesive layer, and

thus efficiency in transfer (i.e., removal or cleaning) of toner can be enhanced. Furthermore, extra steps, such as application of an adhesive, can be omitted. Meanwhile, the unshrinkable sleeve 4 may be joined with the core roller 3 by use of an adhesive, so long as the adhesion force between the sleeve 4 and the core roller 3 is comparable to the aforementioned welding force.

According to the roller member 1 of the present invention, the unshrinkable sleeve 4 exhibits excellent charge-imparting characteristics with respect to toner, and thus efficiency in transfer (i.e., removal or cleaning) of toner adhered onto a transfer belt is enhanced. Specifically, when the unshrinkable sleeve 4 is formed from a polyamide or polyamide elastomer, efficiency in transfer (i.e., removal or cleaning) of toner is enhanced, since an amido group contained in such a compound has high affinity to toner. Also, when the unshrinkable sleeve 4 is formed from a fluorine-containing polymer compound or fluorine-containing elastomer, efficiency in transfer (i.e., removal or cleaning) of toner is enhanced, since a fluorine atom contained in such a compound has high affinity to toner.

The roller member of the present invention is used as a cleaning roller for removing toner adhered onto a transfer belt or a transfer-conveyor belt. In addition, the roller member may be used as a charge-eliminating roller or a charge-imparting roller.

EXAMPLES

The present invention will next be described in more detail by way of Examples.

Example 1

A core roller was formed from stainless steel (SUS). The core roller was coated with an unshrinkable sleeve having a thickness of 100 μm, a Young's modulus of 140 MPa, and a surface resistivity of 10^9 Ω/□. The resultant core roller was heated at 162°C for 60 minutes, to thereby heat-weld the sleeve onto the core roller and produce a roller member.

Example 2

The procedure of Example 1 was repeated, except that an unshrinkable sleeve having a Young's modulus of 180 MPa and a surface resistivity of 10^{12} Ω/□ was used, to thereby produce a roller member.

Comparative Example

A metallic roller formed from SUS was used as a comparative roller member.

Test Example

The roller member of each of the Examples 1 and 2 and Comparative Example was installed in a copy machine and used as a roller for cleaning a transfer belt. A durability test in which a text was printed out a predetermined number of times was performed, to thereby evaluate the degree of removal of toner adhered onto the transfer belt. Toner transferred onto the roller member was scraped off by use of a conventional cleaning blade. The results are shown in

Table 1.

Table 1

Copied sheet count (times)	1,000	5,000	10,000	50,000
Example 1	AA	AA	AA	BB
Example 2	AA	AA	AA	BB
Comparative Example	AA	BB	BB	CC

AA: excellent, BB: good, CC: toner remains on the belt

As shown in Table 1, when the roller member of Example 1 or 2 is used, toner adhered onto the transfer belt is satisfactorily removed, even after a text was printed out 50,000 times. In contrast, when the roller member of Comparative Example is used, toner remains on the transfer belt after the text was printed out 50,000 times, although toner adhered onto the belt is satisfactorily removed when the text was printed out as many as 10,000 times.

The results show that the roller member of the present invention exhibits improved durability and enhanced performance for removal of toner adhered onto a transfer belt, as compared with a conventional roller member.

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As described above, the roller member of the present invention exhibits excellent charge-imparting characteristics with respect to toner, and thus exhibits enhanced performance for removal of toner. In addition, toner filming does not occur easily, and durability of the roller member is enhanced.